US005337786A

United States Patent [19]

Rush et al.

[11] **Patent Number: 5,337,786**

[45] **Date of Patent: Aug. 16, 1994**

[54] **SLIDE ACTUATION VALVE**

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[73] Assignee: **MTD Products Inc.**, Cleveland, Ohio

[21] Appl. No.: **938,569**

[22] Filed: **Aug. 31, 1992**

Related U.S. Application Data

[63] Continuation of Ser. No. 742,228, is a continuation of Ser. No. 549,975, Jul. 9, 1990, abandoned.

[51] **Int. Cl.**[5] **F15B 13/04**

[52] **U.S. Cl.** **137/625.68**; 137/625.69

[58] **Field of Search** 137/625.68, 625.69; 285/211

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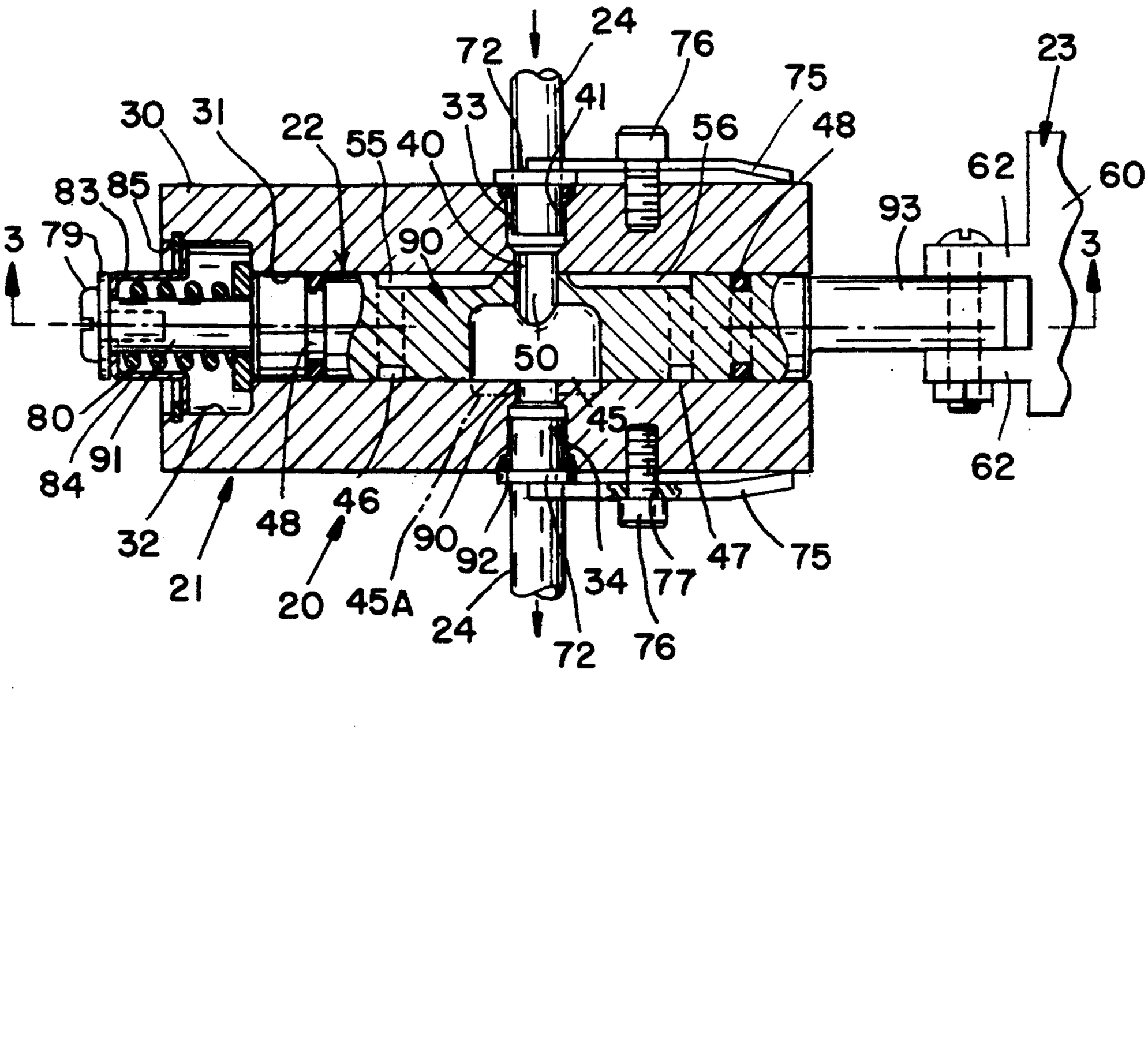
Primary Examiner—Gerald A. Michalsky
Attorney, Agent, or Firm—Lightbody Law Office

[57] **ABSTRACT**

A slide valve is disclosed utilizing simple straight through drilled holes in the body of the valve in combination with a machined central fluid return passage and extensions off of the cylinder grooves in the valve slide.

25 Claims, 4 Drawing Sheets



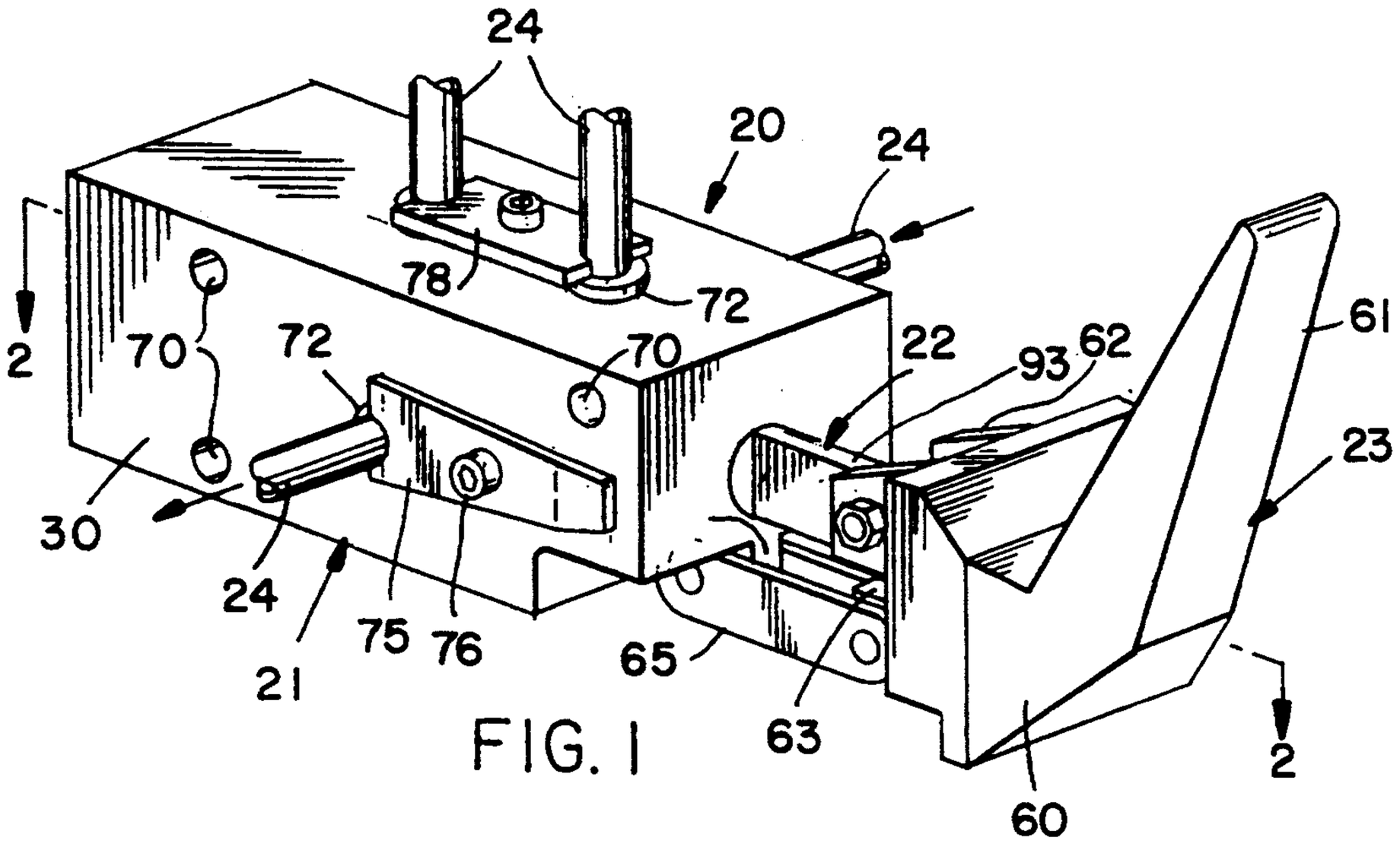


FIG. 1

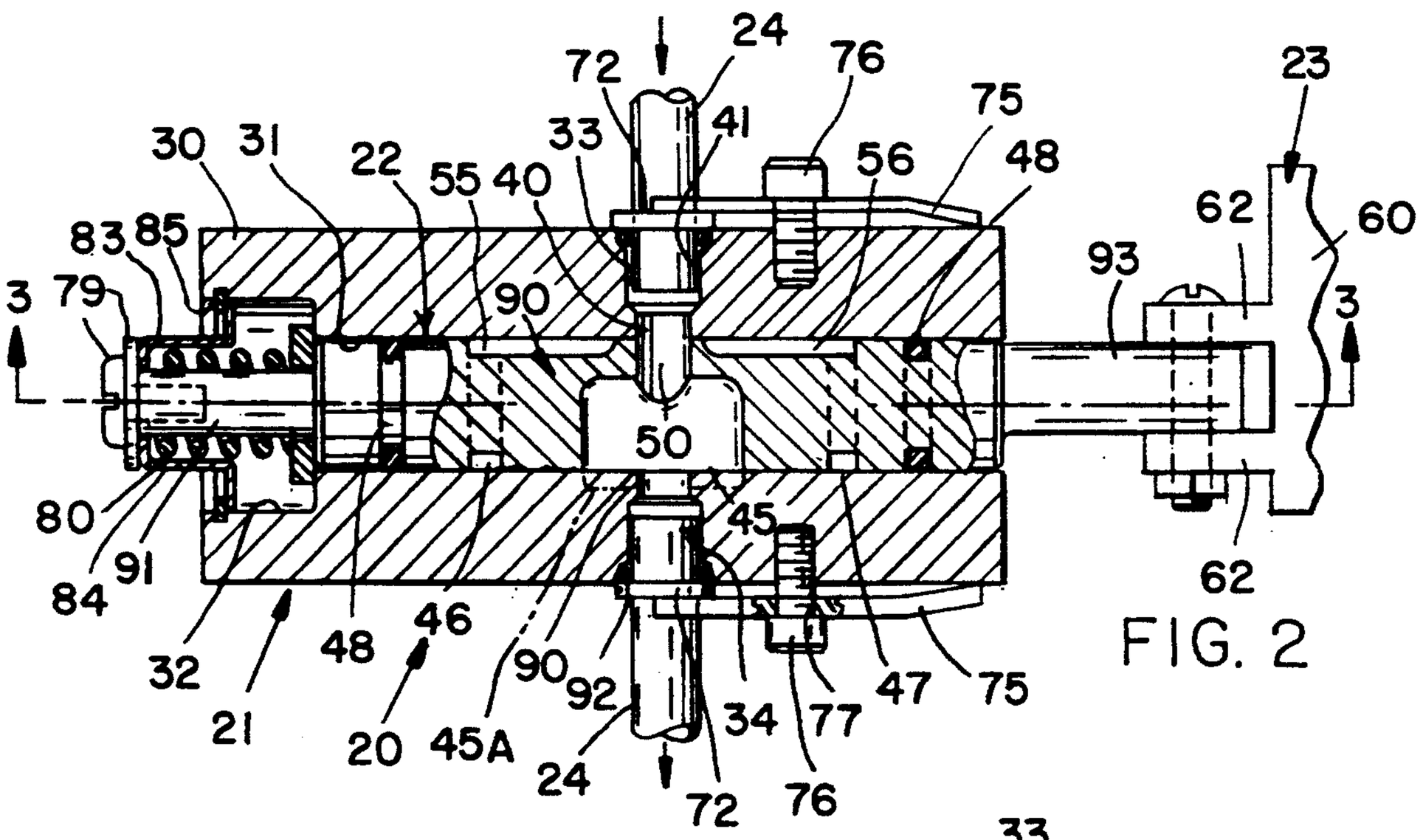


FIG. 2

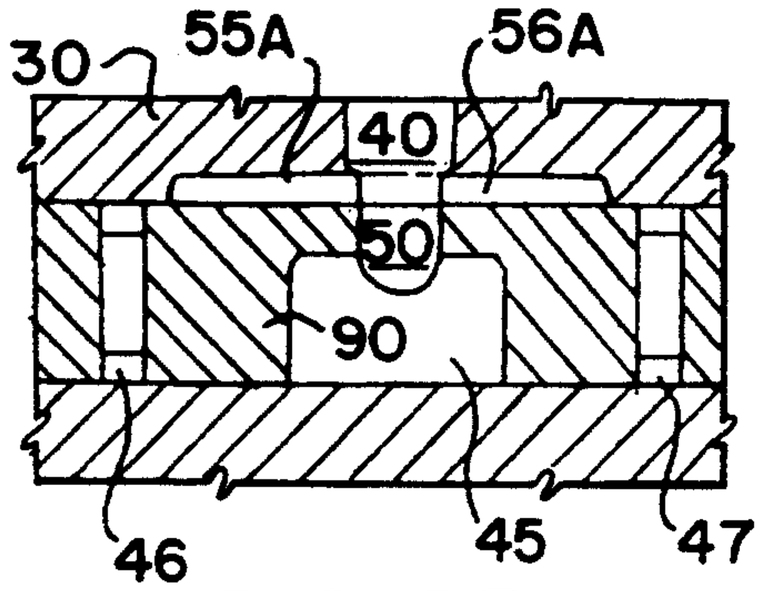


FIG. 2B

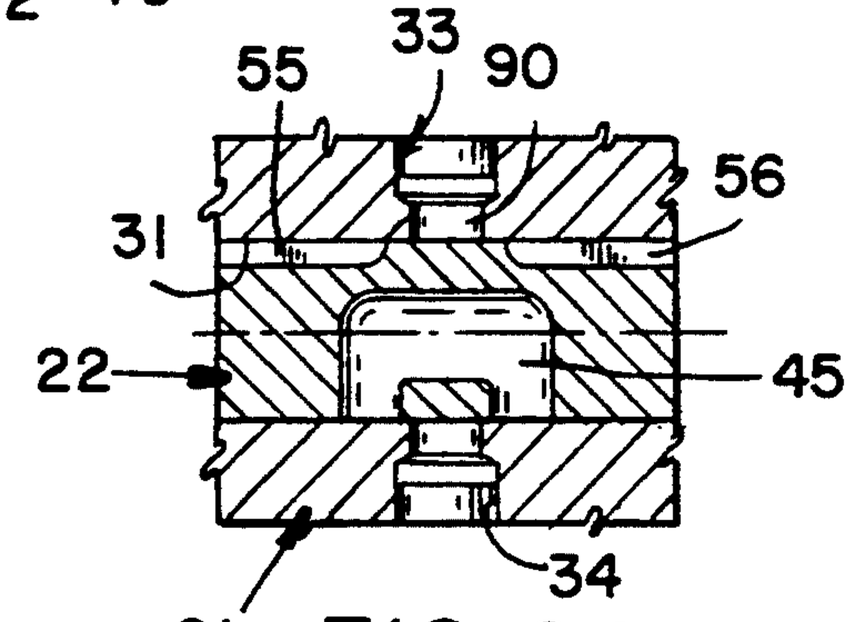


FIG. 2A

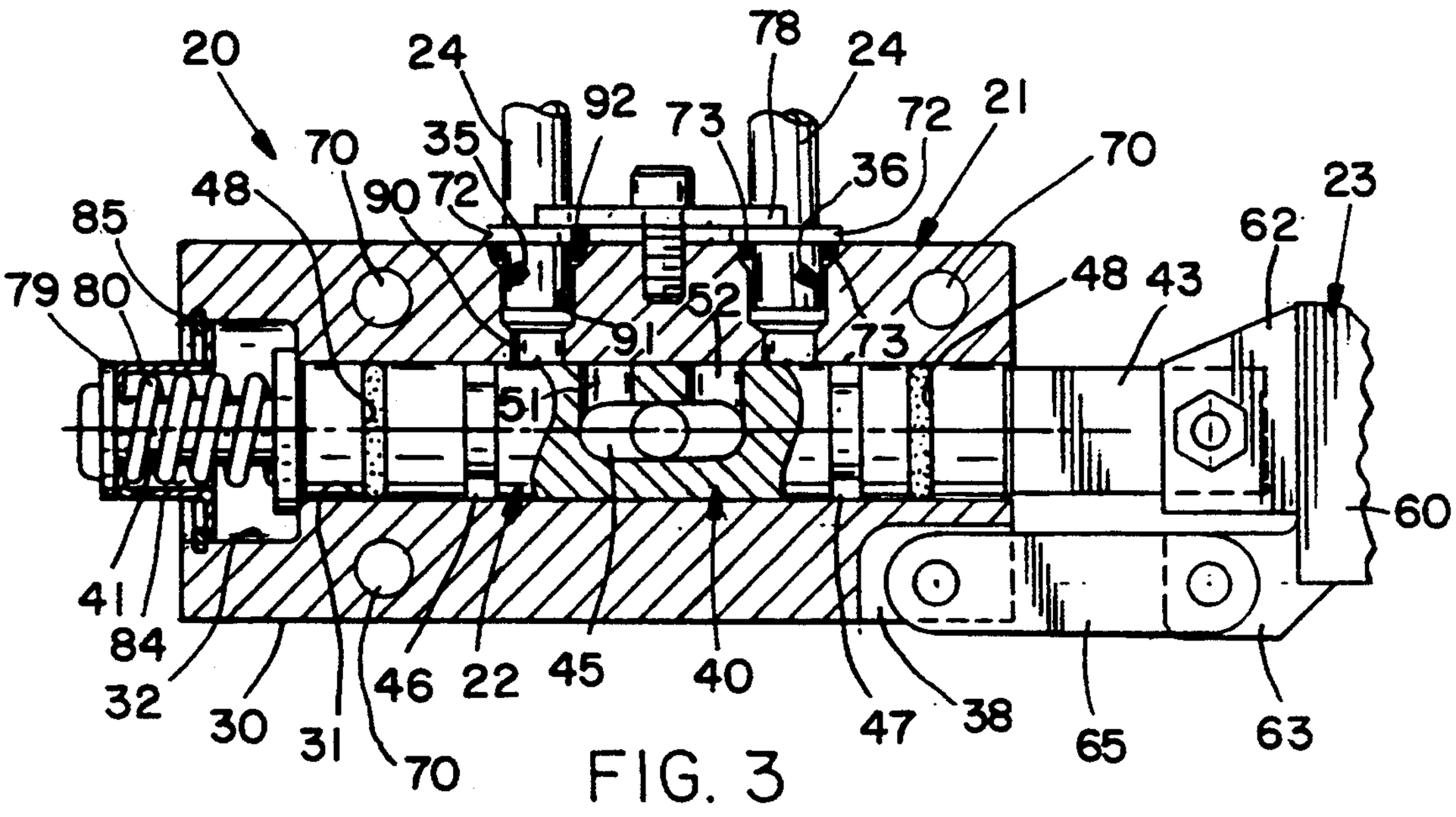

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FIG. 3

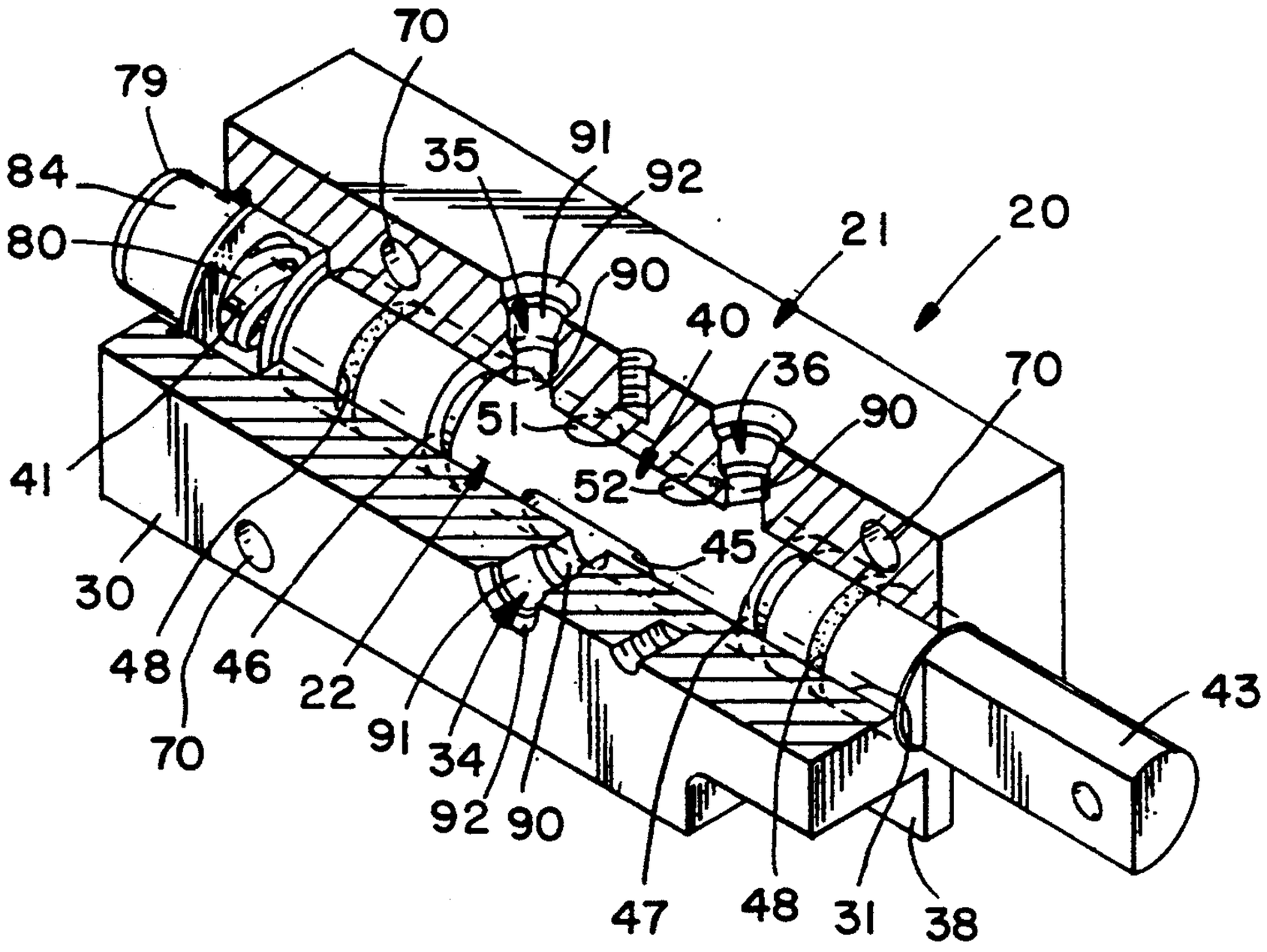
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FIG. 4

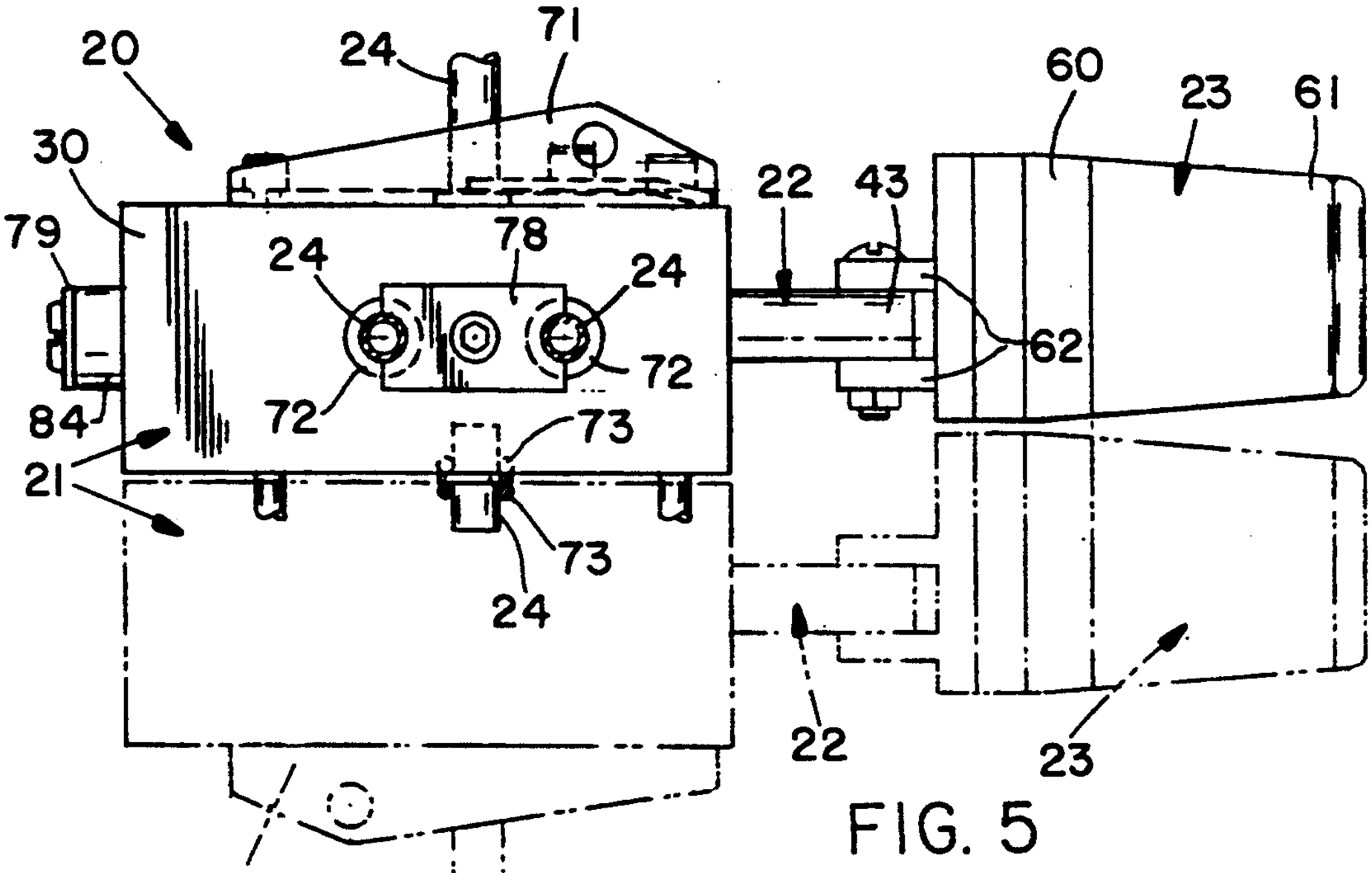

FIG. 5

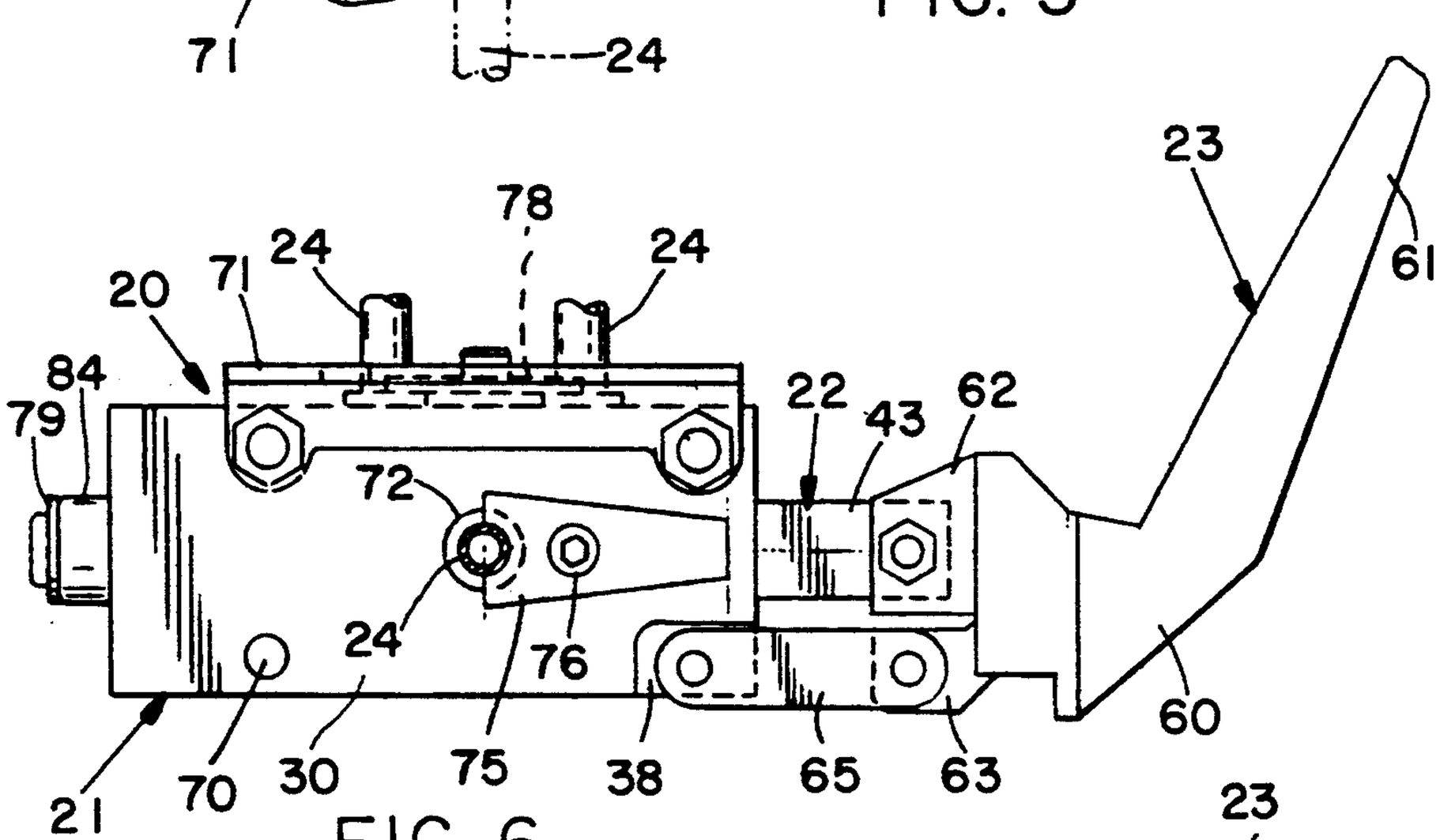

FIG. 6

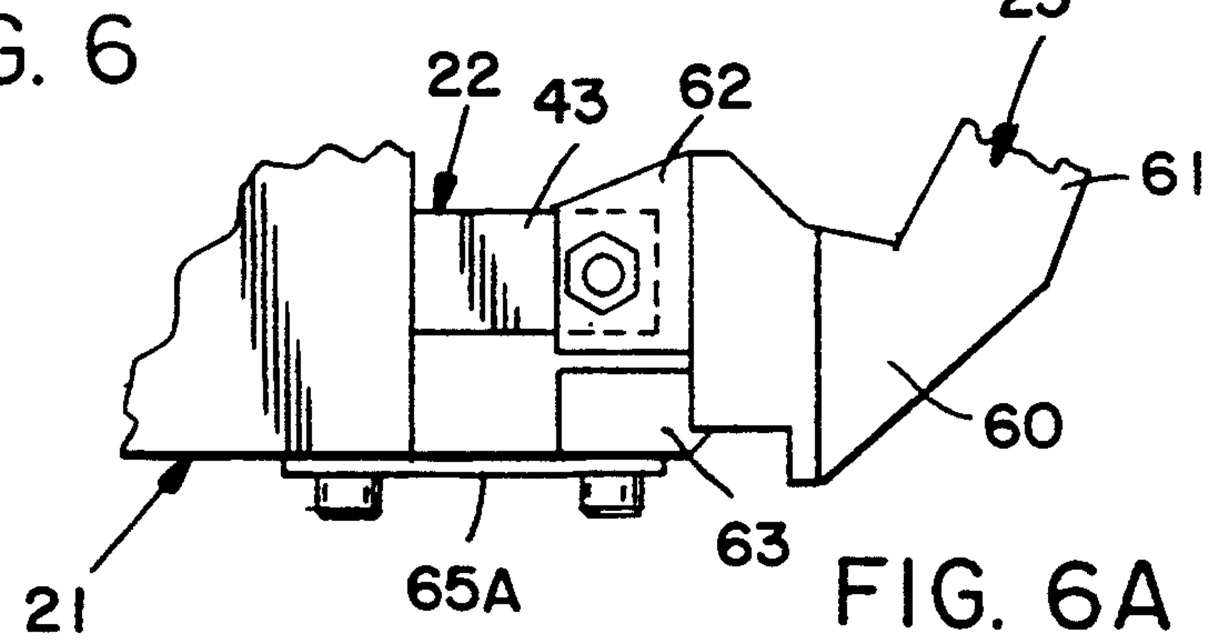

FIG. 6A

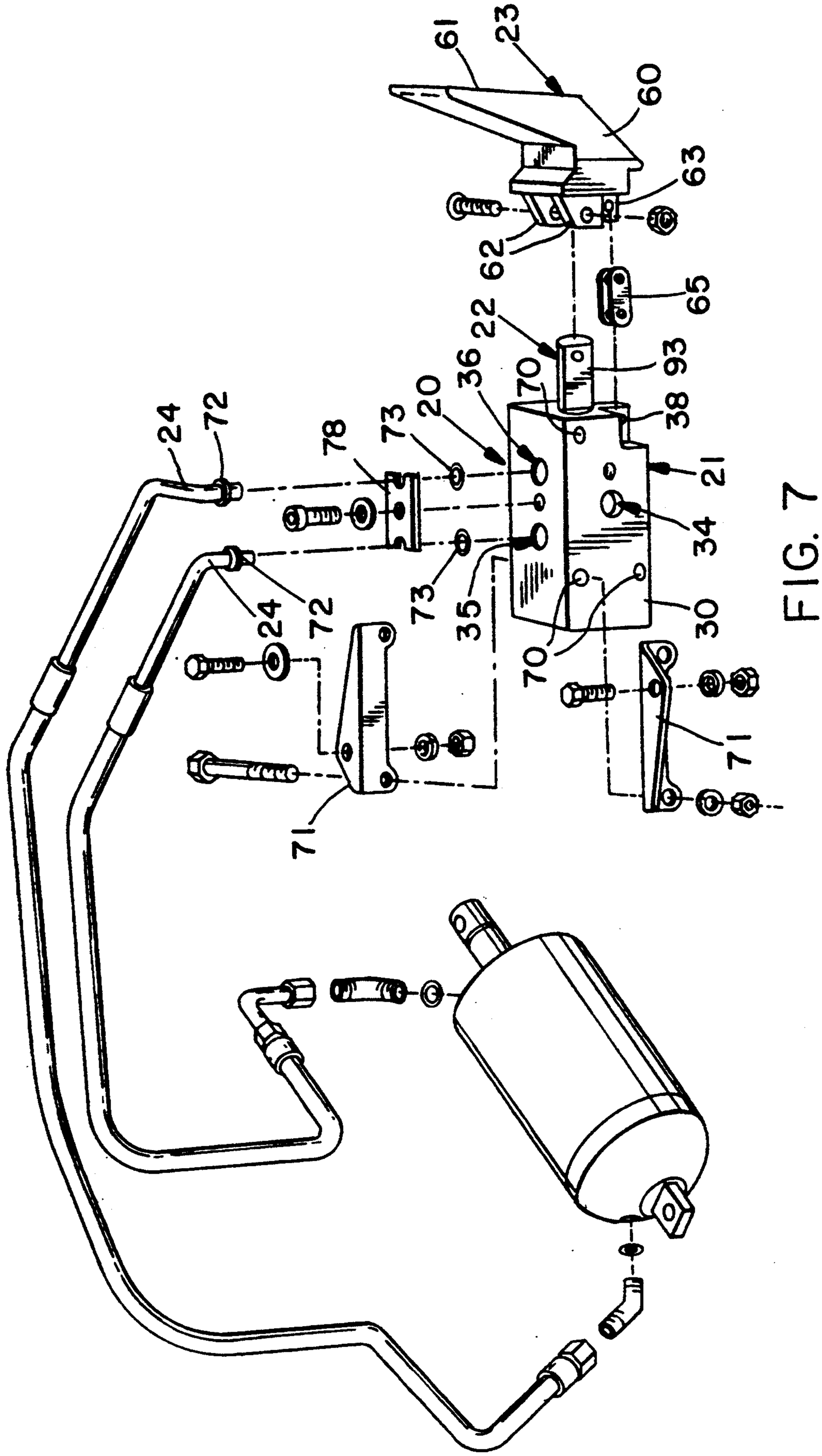

FIG. 7

SLIDE ACTUATION VALVE

This is a continuation application of Ser. No. 07/742,228 filed Aug. 6, 1991, now abandoned which is a continuation application of Ser. No. 07/549,975 filed Jul. 9, 1990, now abandoned.

This invention relates to a slide actuation valve for hydraulic, pneumatic or other fluidic pressure devices.

BACKGROUND OF THE INVENTION

Historically slide valves for fluidic controls have been very large weighty units designed to provide a controllable non-leaking selective interconnection of the various lines which are fed into the valve. The valves themselves are complex devices needing multiple intricate machining operations and subsequent maintenance in order to insure continual satisfactory performance. These valves are thus of significant size, weight and cost. These combine to limit the number of applications for such valves.

OBJECTS OF THE INVENTION

It is an object of this present invention to reduce the size of fluidic valves.

It is an object of this invention to reduce the complexity of fluidic valves.

It is an object of this invention to reduce the cost of fluidic valves.

It is an object of this invention to increase the service life of fluidic valves.

Other objects and a more complete understanding of the invention may be had by referring to the drawings in which:

DRAWINGS

FIG. **1** is a perspective view of a valve including the invention of the application and including external lines and application lever;

FIG. **2** is a longitudinal plan cross sectional view of the valve of FIG. **1** taken substantially in the plane **2**—**2** of such figure;

FIG. **2A** is a partial view like FIG. **2** of a closed center embodiment modification of the preferred embodiment;

FIG. **2B** is a partial view like FIG. **2** of alternate valving arms;

FIG. **3** is a longitudinal cross sectional view of the valve of FIG. **1** taken substantially along plane **3**—**3** of FIG. **2**;

FIG. **4** is a cut away perspective view of the valve of FIG. **1**;

FIG. **5** is a plane view of the valve of FIG. **1**;

FIG. **6** is a side view of the valve of FIG. **1**; and,

FIG. **6A** is a partial view like FIG. **6** of a modified link reaction member;

FIG. **7** is an exploded perspective view of a tractor cylinder control incorporating the valve of FIG. **1**.

DESCRIPTION OF THE DRAWINGS

This invention relates to a reduced sized hydraulic, pneumatic or other fluidic substance valve. The invention will be described in its preferred embodiment of a hydraulic valve for a remote cylinder on a lawn and garden tractor.

The valve **20** has a valve body **21**, a valve slide **22**, an actuator lever **23**, and interconnecting pipes or hoses **24** (FIGS. **1**, **5** and **6**).

The valve body **21** for the hydraulic valve mechanically interconnects the other parts of the improved valve together as well as mounts the valve **20** on the associated physical structure (for example the body or frame of a tractor). The preferred valve **20** is a double throw double pole valve interconnecting a source of pressure and a return to an actuation cylinder having bidirectional operation—i.e. first and second cylinder connections on either side of a movable piston. The preferred valve **20** is biased into a no-connection fluid pass through default position. Other types of valves with other modes of operation, connections and biased positions could also be made incorporating the invention of this application.

The particular preferred double throw double pole valve **20** shown has a rectangular body section **30** substantially 1.73″ square by 3.75″ long. An operational hole **31** substantially $\frac{5}{8}$″ in diameter extends longitudinally axially through the center of the body section **21**. In the preferred embodiment shown the operational hole **31** terminates at one end in an enlarged cylindrical centering opening **32** (FIGS. **2**, **3** and **4**). This centering opening **32** is for utilization with an internal centering mechanism (later described). If desired this enlarged opening **32** could be omitted (with appropriate modifications to the later described centering mechanism).

The body section **30** can be extruded with the operational hole **31** subsequently honed to precise size. The body section **30** could also be machined with the hole **31** drilled to size. Alternately the body section could be formed of plastic, molded about an inner steel sleeve of tubing (preferably pre-honed to size). In any event it is preferred that the enlarged centering opening **32** be added after formation of the body section **30** (if such is utilized).

Four further operational holes **33**–**36** extend in the body section **30** from exterior surfaces to intersect the hole **31**. It is preferred that these holes **33**–**36** be drilled or milled into the body section **30**. These four holes create four openings: a pressure opening **33**, a return opening **34**, a first cylinder opening **35**, and a second cylinder opening **36**. Each of the four openings **33**–**36** includes an intersection **90** at the hole **31**. This intersection **90** is dimensioned in order to pass the volume of fluid required at the operating pressures of the valve respectively in the manner desired by the valve designer. In the particular embodiment shown, the intersection **90** is a simple circular hole substantially 3/16″ in diameter. This circular shape is preferred for its ease of manufacture and for its low fluid pressure drop in operation. An intermediate section **91** interconnects this intersection **90** to the external surface of the body section **30** of the valve. The outer diameter of this intermediate section **91** is selected to match the termination desired, in this case the outer diameter of the pipes **24** which will be utilized with the valve to fluidically interconnect such valve **20** to the cylinder. This termination allows the pipe **24** to directly interconnect to the body section **30** of the valve without the necessity of additional plugs or fittings (which may be appropriate or desired in other applications). The intermediate section **91** flairs into a seal groove **92** at the intersection with the external surface of the body section **30** of the valve. This seal groove serves to aid the sealing of the pipe **24** to valve body **21** as later described. Note that each of the four openings **33**–**36** are of identical configuration down to their circular intersection **90**. This is the preferred embodiment for ease of construction. Indeed a

shaped drill or mill is preferably utilized to manufacture the entire set of four openings **33–36** disclosed, each in a single operation. If desired the openings for the valve could be individually customized to meet desired operating, construction or individual piping parameters. An example of this would be to taper the intersections **90** for the cylinder openings **35, 36** so as to facilitate the feathering control thereof. Another example would be to tap an opening for a threaded fitting. Other modifications to the number and/or shape of the openings could also be made.

Although the exact positioning of the four openings **33–36** in the preferred embodiment is not critical as long as the openings relate in operation with the other openings as later described, it is preferred that the pressure opening **33** be one flat side of the body section **30** of the valve with the return opening **34** located on the opposing flat side of the body section **30**. This provides for a straight through default fluid pass through neutral position. This lowers any pressure loss through and the heat gain for the valve. It also facilitates the design and construction of the valve by reducing thermal dimensional tolerances considerations. It is preferred that the cylinder openings **35, 36** be located as a pair off of a third flat side of the body section **30** of the valve **20**. The preferred orientations simplifies construction (simple 90° orientations between openings, two openings on one side) and facilitates the interconnection of the cylinder pipes **24** to the valve **20**.

The valve slide **22** is located within the hole **31** of the body section **30** of the valve **20** for axially sliding movement in respect thereto. This sliding action selectively interconnects the various openings to provide for the valves operation. The preferred slide valve **22** includes a main actuation section **40**, a centering extension **41**, and a tab extension **43**.

The main actuation section **40** of the valve slide **22** is the operating mechanism for the valve, selectively interconnecting the various openings **33–36** to provide for the valving action. The clearance about the diameter of the preferred main actuation section of the slide valve is substantially 1/2000". This clearance is designed such that the slide valve **22** can be easily constructed and assembled while at the same time insuring an acceptable amount of bypass leakage between the various openings without the necessity of separate physical seals between such openings. A clearance below 1/1000" is preferred to provide this sealing in the application described. Due to this construction, no physical seal need pass over an opening or be otherwise subjected to high wear. This increases the longevity of the valve. As there are two physical seals (later described) that isolate the fluid area of the valve from the outside world, any bypass leakage is retained within the valve.

The main actuation section **40** itself includes a central passage **45**, two cylinder actuation grooves **46, 47** and two seal grooves **48** (FIGS. **2, 3** and **4**).

The central passage **45** serves to interconnect the return opening **34** with the pressure **33**, cylinder one **35**, or cylinder two **36** openings (depending on the positioning of the valve slide **22**). It is preferred that the central passage **45** be in constant communication with the return opening **34**. This lowers the pressure within the valve **20** by constantly draining off any stray high pressure fluid. (Note that the equivalent of the central passage **45** could be provided by a straight through single diameter hole in the valve slide **22** in combination with a slot **45A** cut into the section **30** of the valve **20** on either side of the intersection **90** for the return opening **34**. However, as this would entail an additional manufacturing step on the inside of the body section **30**, it is not preferred.) In the normal non-actuated condition of the preferred valve **20** (FIG. **2**), the return opening **34** is directly interconnected to the pressure opening **33** through a portion **50** leading straight through the valve slide **22** off of the central passage **45**. In this non-actuated condition of the valve **20**, the fluid from the pressure opening **33** is therefore passed straight through to the return opening **34** completely bypassing the cylinder one **35** and cylinder two openings **36**. Two drilled holes **51, 52** extend upwards in the actuation section **40** off of the central passage **45**. As can be seen from FIG. **3** upon shifting of the actuation section **40** inwards into the body section **30** of the valve, the central passage **45** is interconnected to the cylinder one opening **35** via the portion **51**. This connects the cylinder one opening **35** to the return opening **34**. The same action would at least partially close the interconnection between the pressure opening **33** and the hole portion **50** of the central passage **45** which is adjacent thereto. This disconnects the bypass between pressure **33** and return **34**. As also can be seen in FIG. **3** upon shifting of the main actuation section **40** of the slide valve **22** outwards of the body section **30** of the valve, the central passage **45** is interconnected to the cylinder two opening **36** via the hole portion **52**. This connects the cylinder two opening **36** to the return opening **34**. This would at least partially close the interconnection between the pressure opening **33** and the central passage **45**. Again this would disconnect the bypass between pressure **33** and return **34**. Due to the unique trident shape of the central passage **45**, the return opening **34** can thus be selectively interconnected to either the pressure **33**, cylinder one **35**, or cylinder two **36** openings via the axial movement of the main actuation section **40** of the valve slide **22**.

There are two actuation grooves **46, 47** axially displaced from the central passage **45** in the main actuation section **40** of the valve slide **22**. The straight shoulder, circular grooves **46, 47** shown are preferred due to their ease of manufacture and operational longevity. Other shapes, such as tapered shoulders or non-circular grooves, could also be utilized if desired to provide differing actuation characteristics. The preferred actuation grooves **46, 47** are displaced from the holes **51, 52** by a distance slightly greater than the diameter of the effective opening of the cylinder one **35** and cylinder two **36** openings respectively. This insures a null condition in which the cylinder one opening **35** and the cylinder two opening **36** are not interconnected to either pressure **33** (via grooves **46, 47**) or return **34** (via holes **51, 52**). A distance greater than the difference in diameter between the actuation member **40** and the hole **31** is further preferred. Any additional distance comprises speed of initial actuation against sealing—i.e. the greater the additional distance, the slower the initial actuation but the greater the sealing (and the null condition) and visa versa. In the preferred embodiment disclosed, the distance is 0.003". Note that both the cylinder one actuation groove **46** and the cylinder two actuation groove **47** have an extension section (**55, 56** respectively), which are asymmetrically located neighboring the portion **50** of the central passage **45** adjacent to the pressure opening **33**. These extension sections **55, 56** act to equalize the spacing of the actuation grooves **46, 47** from the pressure opening **33**—i.e. insure that upon movement of the valve slide **22**, the cylinder openings **35, 36** valve to

the pressure **33** and return **34** openings at substantially the same time. This is preferred. The distance between the end of these extension sections **55, 56** and the portion **50** is therefore preferably equal to or slightly greater than the distances between the cylinder openings **35, 36** and the respective return connection holes **51, 52**. This insures that the cylinder openings **35, 36** are interconnected to the pressure opening **33** at the same time as or shortly subsequent to the return opening **34**. (If other operations are desired, distances can be altered if desired. An example of this would be sequential action when a cylinder opening is connected to a corresponding groove before pressure is connected to the extension section off of the groove.) The extension sections **55, 56** allow for a selective interconnection between the cylinder one **46** and cylinder two **47** actuation grooves respectively and the pressure opening **33**. (Note that the equivalent of the two extensions **55, 56** could be provided by cutting two arms **55A, 56A** in the body section **30** of the valve **20**. In that this would necessitate an additional manufacturing operation on the inside of the body section, this change is not preferred.)

The two grooves **48** on either side of the actuation groove **46, 47** contain "O" rings. These "O" rings contact the inner diameter of the hole **31** in the body section **30** of the valve so as to insure that there will be no external leakage of the fluid to the outside of the valve. The other seals in the valve **20** between the various grooves, passages, and extensions within the valve body and about the main actuation section **40** are provided by the limited clearance between the outer diameter of the main actuation section **40** and the inner diameter of the hole **31**. These clearances, in the range below 1/2000", provide sufficient sealing for the pressures involved in the preferred embodiment (hydraulic motor oil at substantially 1,200 PSI normal operating pressure and 180° F. operating temperature). This is especially so considering the presence of the "O" ring seals between the fluid area of the valve and the outside world and the constant low pressure return opening in the center of the valve (including the central passage). Any stray fluid bypass is contained within the valve. With other temperatures and pressures other ranges of clearance as seals may be appropriate. In general: A) the lower the viscosity of the oil; B) the higher operating pressure; and, C) the higher operating temperature, the smaller and/or wider the clearance must be to provide a seal.

Upon shifting of the main actuation section **40** inwards of the body section **30** of the valve, the extension section **56** will interconnect the cylinder two actuation groove **47** with the pressure opening **33**. Since the cylinder two actuation groove **47** will interconnect with the cylinder two opening **36** substantially simultaneously (as seen in FIG. **3**), this inward motion will selectively interconnect the pressure **33** opening with the cylinder two **36** opening. At the same time this pressure/cylinder two valving is taking place, the same inward shifting of the main actuation section **40** will interconnect the central passage **45** to the cylinder one opening **35** via the hole **51**. Since this central passage **45** is in constant communication with the return opening, this inward action selectively connects the cylinder one opening **35** with the return opening **34** to complete the other half of the valving of this preferred embodiment.

An outward motion of the main actuation section **40** will selectively interconnect the pressure opening **33** with the cylinder one opening **35** in a similar manner via the extension section **55** and the cylinder one actuation groove **46**. Again at the same time this pressure/cylinder one valving is taking place the same inward shifting of the main actuation section **40** will interconnect the cylinder two opening **36** with the return opening **34** (via the hole **52** and the central passage **45**). Thus an inward motion of the main actuation section **40** will selectively interconnect the pressure opening **33** with the cylinder two opening **36** while also interconnecting the cylinder one opening **35** with the return opening **34** while an outward motion of the main actuation section **40** of the valve slide **22** will interconnect the pressure opening **33** with the cylinder one opening **35** and the cylinder two opening **36** with the return opening **34**. The inward and outward motion of the main actuation section **40** will thus selectively valve the four openings. Note that by omitting the portion **50** leading to the pressure opening **33**, a closed center operation can be provided for the valve **20** (FIG. **2A**). This change can be accompanied/-replaced by a similar connection to the return **34** opening by drilling two holes for the central passage **45** instead of milling a wide slot opening (again FIG. **2**).

The centering extension **41** of the valve slide **22** insures that the main actuation section **40** is biased in a predetermined position. In the embodiment shown this predetermined position is a neutral condition in which the pressure opening **33** is connected directly to the return opening **34** with the cylinder one **35** and cylinder two **36** openings not terminated to either pressure **33** or return **34**. Other predetermined conditions could also be provided. The centering section **41** disclosed accomplishes the biasing action by having a biasing spring **80**. In an inward movement of the valve slide **22**, the spring **80** is compressed against the reduced diameter section **83** of the hat shaped end cap **84** (itself located in the centering opening **32** by a "C" ring **85**). This biases the valve slide **22** outwards. On an outward movement, the end cap **84** is moved with the valve slide **22** and the biasing spring **80** is compressed against the body section **30** of the valve **20** by the end cap **84**. A screw **79** interconnects the end cap **84** to the valve slide **22** for this movement. This biases the valve slide **22** inwards. In either movement the release of the valve slide **22** returns the valve **20** to its neutral condition. This allows the main actuation section **40** to be moved inwards and outwards while providing for a return spring pressure against motion in either direction. If desired the centering mechanism could be relocated in the valve, including displacing it off of the end of the valve so as to allow for a unitary diameter hole **31** throughout the length of the valve.

The use of a single spring **80** allows substantially the same compressive force for the biasing action inward and outward. This allows for a more controlled operator movement by equalizing the operative forces in both directions. Note that a continually engaged condition can be provided to the valve **20** by incorporating a spring loaded ball into the valve body **30** and a hole in the valve slide **22** such that movement of the valve slide **22** engages the ball with the hole. (Release would occur when the operator overrode the interconnection in a further manual operation.) Other operation conditions can also be accommodated by altering the grooves, openings, the springs position and/or by using differing mechanisms or interconnections (for example two different springs, float, normal condition on or off, closed center operation, et al).

The tab extension **43** extends off the other end of the preferred valve slide **22** from the centering extension **41**. This tab extension **43** interconnects the valve **20** with the external actuation member for the device. In the particular embodiment shown, the tab section **43** is machined into the valve slide **22** and the actuation member is the lever **23** (later described). In the particular embodiment disclosed, the lever **23** and tab extension **43** further serve to locate the valve slide **22** in a certain angular position in respect to the body section **30** such that the various openings and extensions are aligned in their proper positions. (For example the extension sections **55, 56** are located adjacent to the pressure opening **33** instead of 180° opposite next to the return section **34**.) The lever **23** and the tab extension **43** thus together play an important part in the valve **20** by insuring that the valve slide **22** is located in its correct operating position. The lever **23** and tab extension **43** accomplish this by being asymmetric. Due to the asymmetry of the mounting of the lever **23** in respect to the tab extension **43**, the actuation section **40** must be correctly oriented in the valve **20**. Therefore if the valve **20** has been assembled, the parts are in their correct operating positions. In the particular embodiment disclosed, the tab extension **43** is asymmetric by having a half moon cross section (asymmetry of the lever later described).

Due to the shape of the central passage **45** and the extensions **55, 56** from the cylinder actuation grooves **46, 47**, the body section **30** for the valve **20** does not need any significant machining or other mechanical operations thereon before utilization in the valve: The six major holes and openings can be provided with a drill or other rotary cutting tool in single operations with simple 90° orientation changes. This significantly simplifies the construction of the body section **30** of the valve. The valve slide **22** in turn can be constructed on a rotary turning machine with the possible exception of the central passage **45** (including holes **51, 52**), the extension grooves **55, 56** and the tab extension **43** (which are easily manufactured on a milling machine or even a drill press). The valve **20** is thus simple to construct on low tolerance machines. In addition most of the parts of the valve can be (and are in the preferred embodiment) made out of simple round or rectangular stock.

The actuator lever **23** is the main operator control for the valve. The actuator lever **23** in addition aid in orienting the main actuation section **40** of the valve slide **22** into its correct operating position. In the embodiment shown the actuator lever **23** is a solid metal member having a body **60** with a handle **61**, a connecting flange **62**, and an actuation flange **63**.

The handle **61** on the actuator lever **23** is designed for manipulation by the operator. Its shape and length is thus made suitable for the particular application involved. The valve **20** shown is utilized in a lawn and garden tractor. For this reason the handle is substantially 3″ long by 1.5″ wide for mounting in the dash next to the steering wheel of such tractor.

The connection flange **62** of the lever **23** mechanically interconnects the actuator lever **23** with the tab extension **43** of the slide valve **22** via a pin type connection. The connection flange **62** itself is located asymmetrically so as to insure that the tab extension **43** (and thus the valve slide **22**) is in its correct angular position upon the mounting of the actuator lever **23** onto the valve **20**. This cooperation between the level **23** and tab **43** can be best seen in FIG. **5** of the application. The actuation flange **63** of the lever **23** in turn cooperates with two links **65** and a tab **38** on the body section **30** of the valve to provide for a reaction member for the actuator lever **23**. These links allow some floating alignment between the lever **23** and valve **20**. These links **65** also orient the actuator lever **23** in respect to the body section **30** of the valve. Note that the tab **38** on the body section **30** of the valve is machined. This produces a strong and familiar mounting for the links **65**, albeit at some cost. If desired the connection flange **62** could be interconnected to a flat side of the valve by making the body side of the link **65** a hinge having an additional flat part and using a bolt to interconnect the additional flat part of the link to the flat side of the valve. A flexible flat non-compressible hinge **65A** could also be utilized (FIG. **6A**). This omission of the tab **38** would further lower the cost for the valve. Again asymmetry is preferred so as to locate the operative parts in their correct position.

Since it is contemplated that the preferred valves **20** will be utilized in multiple banks, the actuator lever **23** is itself in addition located asymmetrically in respect to the body section **30** of the valve. This asymmetric location of the lever **23** insures that adjoining valves **20** will be located in their correct operating positions in respect to each other—i.e. in the embodiment disclosed the pressure inlet of one valve will be aligned with the return outlet of the preceding valve. This is another place where the asymmetry of the actuator lever **23** insures the correct assembly of the valve.

Upon an operator's manipulation of the handle **61** of the actuator lever **23**, the valve slide **22** is moved inwardly and outwardly as previously described to operate such valve.

The body section **30** is mounted to the device with which it will be utilized in the preferred embodiment disclosed via three mounting holes **70** drilled through the body section of the valve. Normally an external mounting flange **71** is bolted to the body section **30** in order to allow a simplified semi-floating mounting.

The pipes **24** interconnect the valve **20** with the outside world, in the particular instance involved—pressure, return, cylinder one, and cylinder two. The pipes **24** as shown in the preferred embodiment are substantially ¼″ in outer diameter with 1/16″ thick side walls. A small 1/16″ by 1/16″ protrusion **72** is connected to the ends of these pipes **24** substantially ¼″ from the end thereof. To assemble the pipes **24** to the valve **20**, an "O" ring **73** is fitted over the end of the pipe next to this protrusion **72**. The ends of the pipes **24** are in turn placed in the intermediate section **91** of the openings with the seal **73** in engagement with the seal groove **92** of such opening. A saddle shaped bracket **75** member is then located on the outside of the protrusion **72** with a screw **76** passing through a hole **77** therein. Upon tightening of the screw **76**, into a threaded hole in the body of the valve, the bracket **75** tightens down against the protrusion **72** so as to interconnect the pipe **24** with the body section **30** of the valve. The compression of the seal **73** between the protrusion **72** and the body section **30** of the valve prevents any external leaks. (The seal groove section **92** acts to retain the "O" ring **73** in its correct positioning as well as providing an expanded sealing surface for the pipe **24**.) The "O" ring **73** allows for some flexing of the pipe **24** in respect to the valve body as well as providing for some overall dimensional tolerances.

Where two pipes **24** are adjoining, for example the cylinder one and cylinder two pipes, an "H" shape bracket **78** is utilized so as to hold both pipes **24** with a

single bracket. If two valves are located next to each other, an in line pipe **24** is utilized having two seals **73** on opposite sides of a single protrusion (see FIG. **5**). Upon the bolting of the two body sections of the valves together, each valve **20** then acts as a bracket in respect to the other valve so as to prevent the leakage on either side of the in line pipe **24**. Washers preferably would be utilized between adjoining valves to provide the appropriate spacing. Alternately the protrusion **72** can be counter sunk into the valve body by an appropriate amount so as to allow a flush junction.

Although the invention has been described in its preferred embodiment with a certain degree of particularity, it is to be understood that numerous changes can be made without deviating from the invention as hereinafter claimed.

What is claimed:

1. In a valve having a body section with pressure, return, and two bi-directional fluid openings and a valve slide having actuation grooves, the valve slide selectively interconnecting the openings upon the axial actuation thereof, the valve used with a reservoir, the improvement of the fluid openings in the body section of the valve being straight through holes for cooperation with the actuation grooves to valve the fluid, there being a single return opening in the body section of the valve emptying to the reservoir, means for the selective actuation of the valve slide to interconnect one of the bi-directional openings to one of the pressure and return openings and to interconnect the other of the bi-directional openings to the other of the pressure and return openings, and one of the actuation grooves including a central passage being aligned with and extending on either side of the return opening directly opening thereto in one given operative position of the valve.

2. The valve of claim **1** characterized in that said central passage opens to said pressure opening in said one operative position of the valve.

3. In a valve having a body section with fluid openings and a valve slide having actuation grooves, the improvement of the fluid openings in the body section of the valve being straight through holes for cooperation with the actuation grooves to valve the fluid, one of the actuation grooves including a central passage extending on either side of one of the openings in one operative position of the valve, another opening, said another opening opening into said central passage in said one operative position of the valve, two additional actuation grooves, said two additional actuation grooves extending on either side of said central passage, two extensions, said two extensions extending towards said another opening respectively, and said two extensions being displaced from said another opening in said one operative position of the valve.

4. In a valve having a body section with pressure, return, and two bi-directional fluid openings and a valve slide having actuation grooves, the actuation grooves on the valve slide having a correct angular orientation in respect to the fluid openings and the valve having an operating lever associated with the valve slide to move such valve axially, the improvement of the fluid openings in the body section of the valve being straight through holes for cooperation with the actuation grooves to valve the fluid, and an asymmetric means on one of the operating lever and the valve slide such that the interconnection of the operating lever to the valve slide angularly orients the actuation grooves on the valve slide in the correct angular orientation in respect to the fluid openings.

5. The valve of claim **4** characterized in that said asymmetric means is on both the operating lever and the valve slide.

6. In a valve having a body section with fluid openings and a valve slide having actuation grooves, the improvement of the fluid openings in the body section being straight through holes, a central passage, said central passage being located in the valve slide, said central passage extending on either side of one of the openings in one operative position of the valve, said central passage communicating with another opening in said one operative position of the valve, two actuation grooves, said two actuation grooves being located in the valve slide on either side of said central passage, a third and fourth opening being located in the body section opening between said two actuation grooves and said central passage in said one operative position of the valve, two extensions, and said two extensions being located in the valve slide extending off of said two actuation grooves towards said another opening and said two extensions being displaced from said another opening in said one operative position of the valve.

7. The valve of claim **6** characterized in that the body section of the valve is a rectangular shaped cube.

8. The valve of claim **6** characterized in that two extensions and said another opening are located on the opposite side of the valve from said one of the openings.

9. The valve of claim **6** wherein the actuation grooves on the valve slide have a preferred angular orientation in respect to the fluid openings and the valve has an operating lever associated with the valve slide and characterized in the addition of an asymmetric means on one of the operating lever and the valve slide such that interconnection of the operating lever to the valve slide angularly orients the actuation grooves on the valve slide in the preferred angular orientation in respect to the fluid openings.

10. The valve of claim **9** characterized in that said asymmetric means is on both the operating lever and the valve slide.

11. The valve of claim **6** wherein the valve is used with a pipe having an end having a diameter and characterized in that an opening has a diameter substantially equal to the end of the pipe with the end of the pipe releasably inserted into the opening, a bracket, and said bracket holding the end of the pipe in the opening.

12. The valve of claim **6** characterized by the addition of a protrusion, said protrusion being located on the pipe spaced from the end thereof, said bracket cooperating with said protrusion to hold the pipe in the opening, a seal, and said seal being about the pipe between said protrusion and the end of the pipe.

13. In a valve having a body section with fluid openings and a valve slide having actuation grooves, the improvement of the body section of the valve being a rectangular shaped cube, the fluid openings in the body section being straight through holes, a central passage, said central passage being located in the valve slide, said central passage extending on either side of one of the openings in one operative position of the valve, said central passage communicating with another opening in said one operative position of the valve, two actuation grooves, said two actuation grooves being located in the valve slide on either side of said central passage, a third and fourth opening being located in the body section opening between said two actuation grooves

and said central passage in said one operative position of the valve, said third and fourth openings having diameters respectively, said two actuation grooves being spaced from said central passage by at least said diameters of said third and fourth openings respectively, two extensions, said two extensions being located in the valve slide extending off of said two actuation grooves towards said another opening, said two extensions being spaced from said another opening in said one operative position of the valve by at least said diameters of said third and fourth openings respectively, said two extensions and said another opening are located on the opposite side of the valve from said one of the openings, said actuation grooves on the valve slide having a preferred angular orientation in respect to the fluid openings, an operating lever, said operating lever being associated with the valve slide, an asymmetric means, said asymmetric means being on one of the operating lever and the valve slide such that interconnection of the operating lever to the valve slide angularly orients the actuation grooves on the valve slide in the preferred angular orientation in respect to the fluid openings.

14. In a valve having a body section with fluid openings and an axially moving valve slide having actuation grooves, the fluid openings including two bi-directional openings and a pressure opening and a return opening, the improvement of the fluid openings in the body section of the valve being straight through holes for cooperation with the actuation grooves to valve the fluid, and means for the actuation grooves to selectively interconnect both of the bi-directional-openings and the pressure opening to the return opening.

15. The valve of claim **14** characterized in that the actuation grooves constantly communicate with one of the pressure opening and the return opening and the actuation grooves selectively communicate with the other of the pressure opening and the return opening.

16. The valve of claim **15** wherein the valve slide has an axis and characterized in that the actuation grooves include pressure grooves to interconnect the pressure opening selectively to the two bi-directional openings and return grooves to interconnect the return opening selectively to the two bi-directional openings, and said pressure grooves overlapping said return grooves along the axis of the valve slide.

17. The valve of claim **14** wherein the valve slide has an axial length and characterized in that one of the actuation grooves includes a central passage extending on either side of one of the pressure and return opening in one operative position of the valve, and said central passage being displaced from both of the two bi-directional openings along the axial length of the valve in said one operative position of the valve.

18. The valve of claim **17** characterized by the addition of two additional actuation grooves on either side of said central passage and two extensions, said two extensions extending towards said another opening respectively, and said two extensions being displaced from said another opening in said one operative position of the valve.

19. In a valve having a body section with a pressure opening and a return opening and two bi-directional openings, and an axially moving valve slide having actuation grooves, the actuation grooves connecting the pressure opening to the return opening in a neutral position with the valve slide selectively interconnecting the pressure and the return openings with the two bi-directional openings upon the actuation thereof off of the neutral position, the improvement of the openings in the body section of the valve being straight through holes for cooperation with the actuation grooves to valve the fluid, and means for the actuation grooves to substantially simultaneously connect the pressure opening to one of the two bi-directional openings while interconnecting the other of the two bi-directional openings to the return opening.

20. The valve of claim **19** wherein the valve slide has an axis and characterized in that the actuation grooves include pressure grooves to interconnect the pressure opening selectively to the two bi-directional openings and return grooves to interconnect the return opening selectively to the two bi-directional openings, and said pressure grooves overlapping said return grooves along the axis of the valve slide.

21. The valve of claim **19** characterized in that the actuation grooves constantly communicate with one of the pressure opening and return opening and the actuation grooves selectively communicate with the other of the pressure opening and return opening.

22. The valve of claim **19** wherein the valve slide has an axial length and characterized in that one of the actuation grooves includes a central passage extending on either side of one of the pressure and return opening in one operative position of the valve, and said central passage being displaced from both of the two bi-directional openings along the axial length of the valve in the one operative position of the valve.

23. In a valve having a body section with a pressure opening and a return opening and two bi-directional openings, and an axially moving valve slide having actuation grooves, the improvement of the openings in the body section of the valve being straight through holes for cooperation with the actuation grooves to valve fluid, a central passage, said central passage being in said valve slide, said central passage communicating constantly with the return opening, and said central passage being selectively connectable to the pressure opening and to one of the two bi-directional openings so as to interconnect same with the return opening.

24. The valve of claim **23** characterized by the addition of two actuation grooves, said two actuation grooves being on either side of said central passage respectively, and means for said two actuation grooves to interconnect one of the two bi-directional openings to the pressure opening selectively as the device is operated.

25. The valve of claim **24** characterized by the addition of two extension sections, said two extension sections extending off of said two actuation grooves respectively towards said central passage, and said two extension sections selectively interconnecting said actuation grooves to said pressure openings.

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